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Impact of the Bovine Population on Milk Production in India

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Abstract

The dairy sector provide food items such as milk, ghee, butter, buttermilk, etc., and non-food items, viz., fiber and skins, draft, and dung. Cattle act as a liquid asset; they possess cultural and religious value, and bullocks are used for farming and sports. Various factors can power milk manufacture, like breed, species, age, lactation length, milking timing, season, feeding means, health, environment, management practice, diet, etc. In India, small, marginal, and landless farmers, who occupy the majority of the total population, contribute a lot to a county's milk production, and they normally own less than five cows or buffaloes. There are conflicting views on the association between the bovine population and milk production. Some researchers have recognized that milk manufacture decrease with an add to in bovine size, while others have finished that bovine size has a considerably positive impact on milk manufacture. So, this paper aimed to look at the impact of the bovine inhabitants on milk manufacture in India.

Keywords: *Milk Production, Bovine Population, Compound Growth Rate, Regression.*

1. Introduction

Animal husbandry and dairying sectors make a substantial contribution to rural livelihoods, especially among landless, small and marginal farmers, and women, as well as supplying nutritious and affordable food to millions of people. (MAHD, Annual Report, 2021-22). This sector also plays an significant role in achieve food security, plummeting global poverty, generate service opportunity for women, and as long as a usual source of income for rural household. (Parida and Yadav, 2020).

In recent decades, just beginning countries have greater than before their share in worldwide dairy production. This enlargement is mostly the result of an add to in information of produce flora and fauna rather than a rise in output per skull. In many just beginning countries, dairy output is forced by poor-quality feed capital, diseases, limited access to market and services (e.g., health, credit and training) and dairy animals' low hereditary potential for milk production. (FAO, 2021). India had the largest cattle population in the world in 2021 followed by Brazil and China. India's cattle's inventory was recorded at 305.5 million head in 2021, accounting for about 30 per cent of the world's inventory. Three country such as India, Brazil and China accounted for around 65 per cent of the world's cattle inhabitants in 2021. Holstein herds big than 1000 cows had a considerably lower total cost of manufacture and a larger milk net income per unit of the shaped milk than do the herds with fewer than 1000 cows. However, Fredeen et al. (1992) study found that herd size correlated negatively with milk yield.

India's milk output reached 195 million tonnes in 2020, due to the continuous rise in dairy cattle numbers and improved feed and fodder availability on favourable monsoon rains (June to September) and the fast mobilisation of the village cooperatives' network and infrastructure development. A study by Mari et al. (2020) approximate that the milk manufacture in India is 198.8 million tonnes in 2019-20 and this will be rising to 285.8 Million Tonnes in 2025-26. a variety of factors power milk manufacture, like number of bovines, breed type, species, age, lactation length, milking timing, season, feeding method, health, environment, management practice, diet, etc.

2. Objectives

1. To know growth in the bovine population in India
2. To study the growth and instability of milk production in India
3. To study the relationship between bovine population and milk production in India.

3. Methods and Materials

The study is based on the secondary data. Milk manufacture data obtained from NDDB website and bovine inhabitants data obtain from various stock poll reports in India. Mean, percentage used to study the bovine population status across the states in India, Compound growth rate (CGR), and Coppock's Instability

Index were used to measure the growth and instability of milk production across the states in India and linear regression and polynomial regression were used to find the relationship between milk productionand bovine population in India.

4. Results and Discussion:

4.1. Bovine inhabitants crossways the state in India

stock includes cattle, buffalo, yaks, mithuns, sheep, goats, livestock, horses & pony, mules, donkeys and camels. Total bovine includes cattle, buffalo, yaks and mithuns. Total bovines population in India was 289.002million in 1992 and it increased to 303.759 million in 2019. However, the share of bovines' population in total livestock population has decreased 61.38 per cent in 1992 to 56.59 per cent in 2019.

Table 1: State-wise bovine inhabitants in India (in '000)

State/UTs	2003	Per cent	2007	Per cent	2012	Per cent	2019	Per cent
AP &Telangana	19930	7.03	24495	8.04	20219	6.74	19279	6.35
Arunachal Pradesh	670	0.24	739	0.24	733	0.24	720	0.24
Assam	9118	3.22	10541	3.46	10743	3.58	11331	3.73
Bihar	16472	5.81	19249	6.32	19799	6.60	23118	7.61
Chhattisgarh	10480	3.70	11095	3.64	11206	3.74	11159	3.67
Goa	113	0.04	108	0.04	89	0.03	87	0.03
Gujarat	14564	5.14	16750	5.50	20370	6.79	20177	6.64
Haryana	7575	2.67	7505	2.46	7893	2.63	6297	2.07
Himachal Pradesh	3012	1.06	3033	1.00	2869	0.96	2477	0.82
Jammu & Kashmir	4194	1.48	4555	1.49	3591	1.20	3256	1.07
Jharkhand	9002	3.18	10287	3.38	9916	3.31	12573	4.14
Karnataka	13529	4.77	14831	4.87	12988	4.33	11455	3.77
Kerala	2187	0.77	1798	0.59	1431	0.48	1444	0.48
Madhya Pradesh	26488	9.34	31044	10.19	27790	9.26	29058	9.57
Maharashtra	22448	7.92	22257	7.30	21078	7.03	19596	6.45
Manipur	516	0.18	413	0.14	341	0.11	272	0.09
Meghalaya	785	0.28	910	0.30	918	0.31	919	0.30
Mizoram	44	0.02	43	0.01	43	0.01	52	0.02
Nagaland	525	0.19	538	0.18	303	0.10	117	0.04
Orissa	15297	5.40	13500	4.43	12347	4.12	10362	3.41
Punjab	8035	2.83	6838	2.24	7587	2.53	6548	2.16
Rajasthan	21268	7.50	23212	7.62	26300	8.77	27631	9.10
Sikkim	168	0.06	140	0.05	145	0.05	154	0.05
Tamil Nadu	10799	3.81	13198	4.33	9594	3.20	10037	3.30
Tripura	773	0.27	968	0.32	960	0.32	746	0.25
Uttar Pradesh	41465	14.63	42695	14.01	50182	16.73	52036	17.13
Uttaranchal	3417	1.21	3456	1.13	2993	1.00	2719	0.89
West Bengal	19999	7.06	19952	6.55	17112	5.70	19709	6.49
A & N Islands	80	0.03	59	0.02	54	0.02	40	0.01
Chandigarh	31	0.01	29	0.01	25	0.01	22	0.01
Daman & Diu	5	0.00	4	0.00	2	0.00	2	0.00
D & N Haveli	54	0.02	61	0.02	46	0.02	41	0.01
Delhi	323	0.11	370	0.12	248	0.08	249	0.08

Lakshadweep	4	0.00	7	0.00	3	0.00	3	0.00
Pondicherry	82	0.03	87	0.03	62	0.02	74	0.02
All India	283448	100.00	304765	100.00	299978	100.00	303759	100.00

Source: Compiled from Indian livestock census of various years

It was mostly caused to refuse of cattle inhabitants i.e., the number of cattle inhabitants was 204.584 million in 1992 and it decrease to 193.463 million in 2019. The split of cattle inhabitants in total stock inhabitants was 43.45 per cent and it decrease to 36.04 per cent in 2019. Sustained decline of indigenous cattle population is considered to be main cause of cattle population shrink over a period of time. Indigenous cattle recorded 40.22 per cent of livestock population in 1992 but it drastically decreased to 26.47 per cent in 2019. At the similar time, the split of buffalo inhabitants has greater than before 17.88 per cent in 1992 to 20.47 per cent in 2019. The split of goat and sheep inhabitants in the total livestock inhabitants was improved considerably from 35.27 in 1992 to 41.58 per cent in 2019.

Table 1 presents the state-wise bovine population in India. Out of 36 states, only 14 states payment in bovine inhabitants was above the nationwide average in the last four stock census (2003, 2007, 2012 & 2019), namely, Andhra Pradesh (United), Bihar, Chhattisgarh, Gujarat, Karnataka, Maharashtra, Rajasthan, Tamil Nadu, Uttar Pradesh, and West Bengal. Besides, about nine states in India had more than five percent livestock during 2003-2019. They are Andhra Pradesh, Bihar, Gujarat, Madhya Pradesh, Maharashtra, Rajasthan, Uttar Pradesh and West Bengal. Uttar Pradesh state had the highest bovine livestock population in the country about 14.63 per cent in 2003 (17th livestock census) and it increased to 17.13 per cent in 2019 (20th Livestock Census).

Madhya Pradesh and Rajasthan tenable the second and third mainly bovine stock crowded states in the country, these accounted for 9.57 and 9.10 percent in that order. According to the last four stock censuses i.e., 2003, 2007 2012 and 2019, there were three states with successive increasing number of bovine stocks; they were Rajasthan, Bihar and Assam.

4.2. The pattern of milk production growth along with instability across the states

The pattern of milk production growth along with instability for different states and union territories over the past two decades was presented in Table-2. In universal, the milk manufacture of the nation is approximate to have full-grown at the rate of 4.82 per cent per annum over the past two decade periods. Bihar showing the highest rate of growth (7.27%) followed by Rajasthan (6.94%). Lakshadweep has record maximum enlargement rate among amalgamation territory. The least enlargement rate found to be Kerala followed by Arunachal Pradesh. It is to be noted that, rise in milk production is observed only in few states of the country.

Table 2: Growth and unsteadiness in milk manufacture for different states and Union territory of India (2000-01 to 2019-20)

States/UTs	CGR (%)	t-statistics	R^2	Instability Index (%)
All India	4.82	48.20**	0.99	48.65
Andhra Pradesh	5.11	12.37**	0.89	50.25
Arunachal Pradesh	1.00	0.79^{NS}	0.03	50.73
Assam	1.43	26.03**	0.97	40.06
Bihar	7.27	14.06**	0.92	56.76
Chhattisgarh	4.21	19.47**	0.95	47.23
Goa	1.20	3.10**	0.35	41.45
Gujarat	5.58	130.44**	1.00	50.75
Haryana	4.57	15.28**	0.93	48.42
Himachal Pradesh	3.80	29.75**	0.98	45.97

J&K	3.65	10.59**	0.86	46.24
Jharkhand	4.67	15.11**	0.93	48.71
Karnataka	3.74	8.44**	0.80	46.91
Kerala	0.77	2.12**	0.20	40.69
Madhya Pradesh	6.89	20.74**	0.96	55.01
Maharashtra	3.90	38.97**	0.99	46.19
Manipur	1.18	9.39**	0.83	39.70
Meghalaya	1.57	21.21**	0.96	40.42
Mizoram	2.95	3.82**	0.45	47.57
Nagaland	1.61	2.80**	0.30	43.67
Orissa	5.04	14.50**	0.92	49.82
Punjab	2.46	16.13**	0.94	42.69
Rajasthan	6.94	29.78**	0.98	54.95
Sikkim	2.66	4.99**	0.58	45.13
Tamil Nadu	3.19	12.56**	0.90	44.77
Telangana@	6.11	20.41**	0.99	41.13
Tripura	5.05	15.32**	0.93	49.79
Uttar Pradesh	4.40	131.22**	1.00	47.46
Uttarakhand	3.12	31.24**	0.98	44.19
West Bengal	2.78	51.48**	0.99	43.28
A&N Islands	-2.26	-3.83**	0.45	45.02
Chandigarh	-0.70	-0.28^{NS}	0.00	39.14
D&N Haveli	1.56	1.47^{NS}	0.10	48.68
Delhi	-0.54	-0.63^{NS}	0.02	45.77
Lakshadweep	5.51	4.45**	0.52	57.03
Pondicherry	1.53	9.54**	0.83	40.59

Note: NS- Statistically insignificant. ** - Significant at I percent level of likelihood.
@ - mix growth rate and unsteadiness in rates of enlargement were work out for the era 2014-15 to 2019-20.

Milk manufacture in the Daman & Diu was record no alter throughout the past two decade.

However, this enlargement in milk manufacture achieved in the face of wide overall fluctuations /instabilities among the state. The coppock's instability index result indicated that the overall instability of the country's milk production was found to be 48.65 per cent. Very high amount of instability notice in the case of states like Bihar, Madhya Pradesh, and Rajasthan and in the case of amalgamation territory high degree of instability observed in Lakshadweep, whereas very low degree of instability recorded in the case of state alike to Manipur, Assam, Meghalaya, and Kerala. In the case of union territory, Chandigarh and Pondicherry record low degree of unsteadiness.

The yield of milk is usually too low to permit a gainful return and the problem is complex by lack of grazing and food land (Chatterjee, 1960). Besides, milk yield varied according to season. The variability of milk production is very high during the flush period than the lean season (Mari, Xavier and Gupta, 2021).

4.3 association Between Bovine inhabitants and Milk manufacture

4.3.1. Linear regression Analysis

Linear weakening examination is a form of predict modelling method which investigate the standard association between a dependent relative (y) and self-governing variable(x). Basically, it helps to find out the best fit line or the regression equation that can be used to make estimation.In this study, it was found that R^2= 0.62, which exposed that 62 per cent of the difference of milk manufacture is strong-minded by the bovine

inhabitants. The linear regression estimated standard error was σ_{est} = 35.642 which revealed that there is small error of prediction. Hence, it can be concluded that the linear regression model is careful to be the good opinion.

The result reveals the following regression equation (1)

$$y = -748.725 + 2.9x \text{-------- } 1$$

Where,

y is the dependent relative changeable (predicted milk manufacture)
x is the vector of the independent variable (Bovine population)
α = -748.725 is the cut off, a steady and
β = 2.9 is the weakening slope

4.3.2. The Quadratic Polynomial Regression

Polynomial weakening is a kind of linear weakening or a particular case of linear deteriorating. It helps to arrive higher-order relationships between X and Y variable. A polynomial whose amount is 2 is documented as a quadratic polynomial.

The study found that R^2= 0.67 which means that 67 per cent of the variation of milk production is determined by the dairy bovine stock size. The standard error of estimation found to be σ_{est} = 36.14 which revealed that there is small error of prediction and it can be concluded that the quadratic regression model is careful to be the good opinion.

Quadratic polynomial weakening for Milk manufacture in India

Y = α + β1*x + β2*x^2

y = 4468.598 - 33.858 x +0.065x^2 --------- (2)

Where,

y is the dependent variable (Predicted milk production)
x is the vector of self-governing changeable (The bovine inhabitants)
α value (4468.598) is constant
β1 value (- 33.858) and β2 value (0.065) are the regression slope.

Table 3: Determinant of milk manufacture by bovine stock size: Linear weakening and Quadratic Polynomial weakening Result

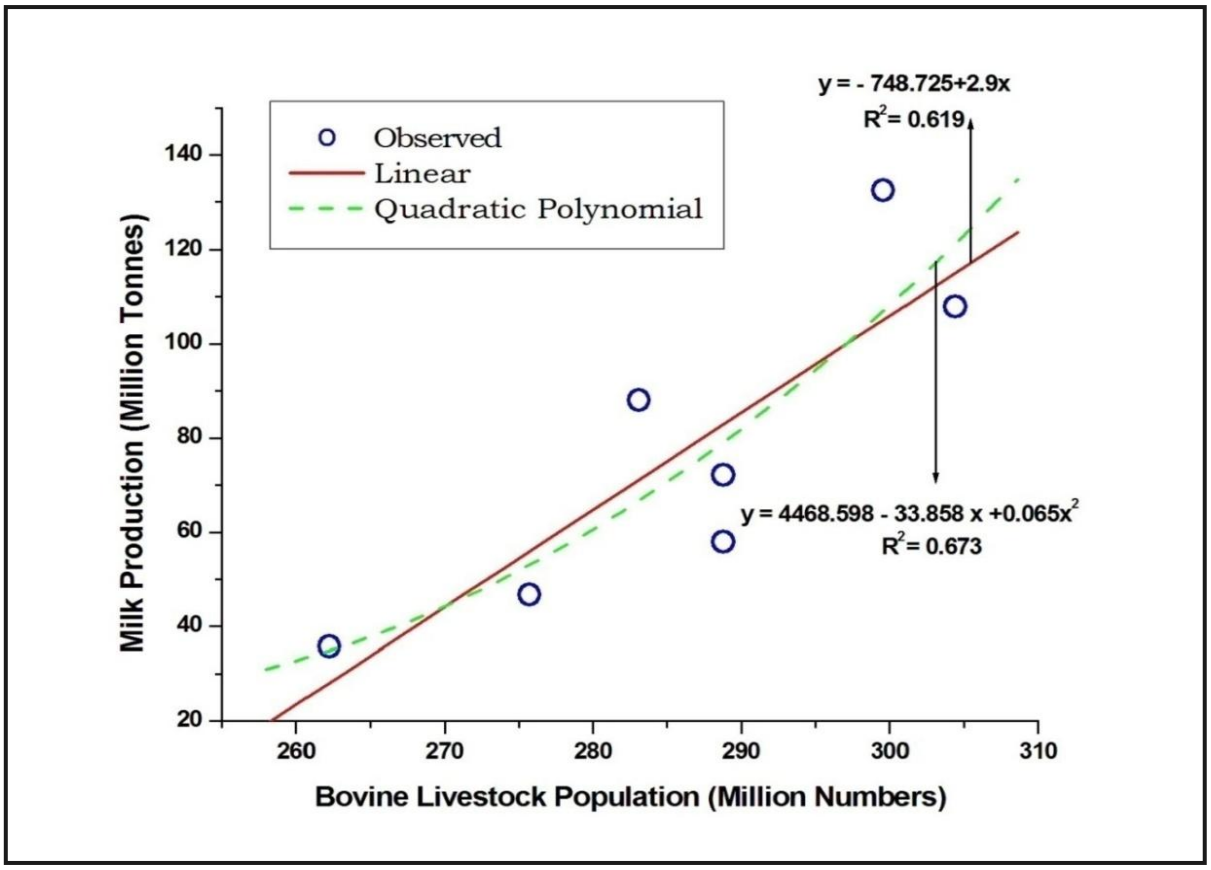
Linear Regression				Quadratic Polynomial Regression			
Parameter	Value	Error	't' value	Parameter	Value	Error	't' value
Constant (α)	-748.72	269.95	-2.774*	α(Constant)	4468.59	5714.161	0.782^{NS}
Slope (β1)	2.91	0.94	3.119*	Slope(β1)	-33.85	40.245	-0.841^{NS}
R^2	0.619			Slope (β2)	0.065	0.071	0.914^{NS}
Adj. R^2	0.555			R^2	0.673		
SE	35.64			Adj. R^2	0.542		
F	9.730*			SE	36.14		
				F	5.149*		

Source: The author's own computation using stock census information and NDDB report.
* - Significant at 5 per cent level of probability, NS – statistically insignificant.

The result revealed that linear regression model techniques had small standard error of estimation (35.64) as compared to quadratic polynomial regression (36.14), which indicated that predicted linear regression model was precision than quadratic polynomial regression. Whereas, t worth was statistically important at 5 per cent level of likelihood for linear weakening and it was unimportant for quadratic polynomial weakening (figure 1). The study revealed that linear regression fits better to the estimation of milk production performance

depending on the number of bovine livestock population in India. This result was consonance with Popescu (2015) finding that linear regression fits better to the evolution of milk production depending upon the bovine livestock in Romania.

Figure 1: Milk manufacture depending on Bovine store Size, Linear and Quadratic Polynomial weakening



5. Conclusion:

The result reveal that the milk manufactures of the nation is approximate to have full-grown at a rate of 4.82 % per annum over the past two decade period. The growth was found to be highest in Bihar (7.27%), followed by Rajasthan (6.94%). It is to be noted that a go up in milk manufacture is experiential only in a a small number of states of the nation. Besides, this growth in milk manufacture was achieved in the face of wide overall fluctuations and instabilities among the state. The coppock's unsteadiness index result indicates that the overall unsteadiness of the country's milk manufacture was found to be 48.65 %.

A extremely high degree of unsteadiness was notice in the case of state like Bihar, Madhya Pradesh, and Rajasthan, and a very low amount of instability was record in the container of state similar to Manipur, Assam, Meghalaya, Kerala. Both linear weakening and polynomial weakening results make known that readily available is a strong positive association between the size of the bovine inhabitants and milk manufacture, and additional, it indicate that the predict linear weakening model was more exact than quadratic polynomial weakening. The result reveal that the buffalo inhabitants greater than before over the period of the last two decades, but the cow inhabitants decreased, chiefly the native cattle inhabitants, which decline radically, so the government should give consideration to enhancing the indigenous cattle population.

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